11-13-00 A

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UTILITY PATENT APPLICATION TRANSMITTAL
(Small Entity)

(Only for new nonprovisional applications under 37 CFR 1.53(b))

Docket No. EUN-KAIST
Total Pages in this Submission

PTO/SB/05 (4/98) Approved for use through 09/30/00. OMB 0651-0032 Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

11/09/00 pc849 U.S. PTO

jc714 U.S. PTO 09/710665 11/09/00

TO THE ASSISTANT COMMISSIONER FOR PATENTS
Box Patent Application
Washington, D.C. 20231

Transmitted herewith for filing under 35 U.S.C. 111(a) and 37 C.F.R. 1.53(b) is a new utility patent application for an invention entitled:

POLYMER COMPOSITE SQUIRREL CAGE ROTOR WITH HIGH MAGNETIC PERMEABILITY FILLER FOR INDUCTION MOTOR AND METHOD OF MAKING IT

and invented by:

Dai Gil Lee, Seung Hwan Chang

If a CONTINUATION APPLICATION, *check appropriate box and supply the requisite information:*

☐ **Continuation** ☐ **Divisional** ☐ **Continuation-in-part (CIP)** of prior application No.: _____

Which is a:

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Which is a:

☐ **Continuation** ☐ **Divisional** ☐ **Continuation-in-part (CIP)** of prior application No.: _____

Enclosed are:

Application Elements

1. ☒ Filing fee as calculated and transmitted as described below
2. ☒ Specification having **15** pages and including the following:
   - a. ☒ Descriptive Title of the Invention
   - b. ☒ Cross References to Related Applications *(if applicable)*
   - c. ☐ Statement Regarding Federally-sponsored Research/Development *(if applicable)*
   - d. ☐ Reference to Microfiche Appendix *(if applicable)*
   - e. ☒ Background of the Invention
   - f. ☒ Brief Summary of the Invention
   - g. ☒ Brief Description of the Drawings *(if drawings filed)*
   - h. ☒ Detailed Description
   - i. ☒ Claim(s) as Classified Below
   - j. ☒ Abstract of the Disclosure

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Application Elements (Continued)

3. ☒ Drawing(s) *(when necessary as prescribed by 35 USC 113)*

   a. ☐ Formal b. ☒ Informal Number of Sheets 8

4. ☒ Oath or Declaration

   a. ☐ Newly executed *(original or copy)* ☒ Unexecuted

   b. ☐ Copy from a prior application (37 CFR 1.63(d)) *(for continuation/divisional application only)*

   c. ☒ With Power of Attorney ☐ Without Power of Attorney

   d. ☐ *DELETION OF INVENTOR(S)*
   Signed statement attached deleting inventor(s) named in the prior application, see 37 C.F.R. 1.63(d)(2) and 1.33(b).

5. ☐ Incorporation By Reference *(usable if Box 4b is checked)*
The entire disclosure of the prior application, from which a copy of the oath or declaration is supplied under Box 4b, is considered as being part of the disclosure of the accompanying application and is hereby incorporated by reference therein.

6. ☐ Computer Program in Microfiche

7. ☐ Genetic Sequence Submission *(if applicable, all must be included)*

   a. ☐ Paper Copy

   b. ☐ Computer Readable Copy

   c. ☐ Statement Verifying Identical Paper and Computer Readable Copy

Accompanying Application Parts

8. ☐ Assignment Papers *(cover sheet & documents)*

9. ☐ 37 CFR 3.73(b) Statement *(when there is an assignee)*

10. ☐ English Translation Document *(if applicable)*

11. ☐ Information Disclosure Statement/PTO-1449 ☐ Copies of IDS Citations

12. ☐ Preliminary Amendment

13. ☒ Acknowledgment postcard

14. ☒ Certificate of Mailing

    ☐ First Class ☒ Express Mail *(Specify Label No.):* EL692935034US

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Accompanying Application Parts (Continued)

15. ☒ Certified Copy of Priority Document(s) *(if foreign priority is claimed)*

16. ☒ Small Entity Statement(s) - Specify Number of Statements Submitted: 1

17. ☐ Additional Enclosures *(please identify below):*

Request That Application Not Be Published Pursuant To 35 U.S.C. 122(b)(2)

18. ☐ Pursuant to 35 U.S.C. 122(b)(2), Applicant hereby requests that this patent application not be published pursuant to 35 U.S.C. 122(b)(1). Applicant hereby certifies that the invention disclosed in this application has not and will not be the subject of an application filed in another country, or under a multilateral international agreement, that requires publication of applications 18 months after filing of the application.

Warning

An applicant who makes a request not to publish, but who subsequently files in a foreign country or under a multilateral international agreement specified in 35 U.S.C. 122(b)(2)(B)(i), must notify the Director of such filing not later than 45 days after the date of the filing of such foreign or international application. A failure of the applicant to provide such notice within the prescribed period shall result in the application being regarded as abandoned, unless it is shown to the satisfaction of the Director that the delay in submitting the notice was unintentional.

UTILITY PATENT APPLICATION TRANSMITTAL
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Fee Calculation and Transmittal

CLAIMS AS FILED

For	#Filed	#Allowed	#Extra		Rate	Fee
Total Claims	6	- 20 =	0	x	$9.00	$0.00
Indep. Claims	2	- 3 =	0	x	$40.00	$0.00
Multiple Dependent Claims (check if applicable) ☐						$0.00
					BASIC FEE	$355.00
OTHER FEE *(specify purpose)* _____						$0.00
					TOTAL FILING FEE	$355.00

☐ A check in the amount of to cover the filing fee is enclosed.

☒ The Commissioner is hereby authorized to charge and credit Deposit Account No. **10-0223** as described below. A duplicate copy of this sheet is enclosed.

- ☒ Charge the amount of **$355.00** as filing fee.
- ☒ Credit any overpayment.
- ☒ Charge any additional filing fees required under 37 C.F.R. 1.16 and 1.17.
- ☐ Charge the issue fee set in 37 C.F.R. 1.18 at the mailing of the Notice of Allowance, pursuant to 37 C.F.R. 1.311(b).

Dated: **November 9, 2000**

Signature

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cc:

PATENT
EUN-KAIST

IN THE UNITED STATES PATENT & TRADEMARK OFFICE

Applicant:	Dai Gil Lee, et al.	)	Examiner: Unknown
Application No. :	TBA	)	
Filing Date:	Herewith	)	Art Unit: Unknown
For:	POLYMER COMPOSITE SQUIRREL CAGE ROTOR WITH HIGH MAGNETIC PERMEABILITY FILLER FOR INDUCTION MOTOR AND METHOD OF MAKING IT	)	

SMALL ENTITY CERTIFICATION
PURSUANT TO CFR § 1.27 & 1.28

Assistant Commissioner for Patents
Washington, D.C. 20231

Dear Sir:

I, Thomas R. FitzGerald, hereby certify that Korea Advanced Institute of Science and Technology located at 373-1 Kusong-dong, Yusong-gu, Taejon 305-705, Republic of Korea is a national university assisted by the government and qualifies for small entity status pursuant to CFR § 1.27 & 1.28.

Dated: 11/9/00

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Docket:
EUN-KAIST

POLYMER COMPOSITE SQUIRRELCAGE ROTOR WITH HIGH MAGNETIC PERMEABILITY FILLER FOR INDUCTION MOTOR AND METHOD OF MAKING IT

BACKGROUND OF THE INVENTION

CROSS-REFERENCE TO RELATED APPLICATIONS

This application claims priority of Korean Patent Application 1999-49704, filed November 10, 1999 and Korean Patent Application 2000-04587, filed January 31, 2000.

FIELD OF THE INVENTION

The present invention relates generally to a squirrel cage rotor for induction motors, and more particularly to a squirrel cage rotor that has a polymer resin part containing powder of high magnetic permeability.

In addition, the present invention relates to a method of fabricating the squirrel cage rotor using jig so as to prevent the conductor bars from being buckled.

DESRIPTION OF THE PRIOR ART

In a rotating body such as a rotor of a motor, a centrifugal force is generated in proportion to the mass of the rotor and the square of the rotational speed of the rotor, so that the rotor with high rotating speed may have, excessive deformation due to a large stress by the centrifugal force.

The quality of machined products mainly depend on the precision of machine tool which is equipped with built-in type spindle system that is composed of the rotor of motor and the

spindle shaft, but the heavy mass of rotor can deterioratedynamic stability of the built-in type spindle system because the heavy mass of rotor may cause excessive stress and deformation. Therefore, it is important to reduce the inertial force of the rotor by reducing mass of rotor.

The rotating speed of a built-in type spindle generally is restricted by a DN value (where D is a bearing nominal diameter in mm and N is the revolutions per minute of the spindle) and the critical whirling vibration frequency of the spindle. In particular, in the case of a built-in type spindle which is composed of the spindle shaft and the rotor of motor, the bending natural frequency is largely influenced by the mass of the rotor of a motor. Accordingly, as the mass of the rotor of a motor is increased, the bending natural frequency of a built-in type spindle is decreased, thus the heavy mass of rotor limits the maximum rotating speed of the built-in type spindle.

Accordingly, for a built-in type spindle rotating at high speed, it is necessary to increase the specific bending stiffness of the built-in type spindle shaft or decrease the mass of the rotor of a motor.

A conventional squirrel cage rotor is illustrated, in Figs. 1 and 2.

As depicted in Figs. 1 and 2, this conventional squirrel cage rotor includes a rotating shaft 11. A silicon steel rotor 12 is fitted around the rotating shaft 17. The silicon steel rotor 12 is fabricated by stacking a plurality of silicon steel sheets 14. Plurality of conductor bars 16 are respectively inserted into the holes 13 and then the two end rings 17 are fabricated by die-casting. Therefore, the conductor bars 16 are short-circuited by two end rings 17 that are positioned at both ends of the silicon steel rotor 12.

Since this conventional squirrel cage rotor has heavy mass due to the high density of silicon steel not only a large centrifugal force is generated inside of rotor body, but also is high torque is required to drive the motor.

In order to solve above problems, Korean Pat. Appln. No. 98-50187 discloses "Composite squirrel cage rotor with magnetic powders and method for fabricating it".

With reference to Figs. 3a .and 4, the invention of this patent is described in detail.

As shown in Figs. 3a and 4, a composite squirrel cage rotor 20 is composed of a composite pipe 22, a rotating shaft 21 and a squirrel cage conductor 23 which is positioned around the pipe 22 and provided with a plurality of slots 24. A plurality of heat pipes 25 may be inserted into the slots 24, respectively.

In this case, the pipe 22 is, fabricated by stacking and curing of composite prepregs which is composed of polymer resin and high strength and modulus fibers. In this case, the pipe 22 is made of fiber reinforced composite material whose polymer resin contains powder of high magnetic permeability such as iron powder in order to improve the performance of the motor.

As depicted in Fig. 3a, this squirrel cage conductor 23 is made of copper or aluminum having high electric conductivity. Plurality of slots 24 are machined along the axis of the squirrel cage conductor 23 by using an end mill or an electric discharge machine tool or a laser machine tool. Each of the slots 24 is formed to be straight along the axis or have a certain angle with the axis. The slots 24 are spaced apart from one another by predetermined regular intervals. In this case, conductor bars and two end rings are integrated into a single squirrel cage conductor 23.

However, this squirrel cage conductor 23 has a problem of high machining cost.

zn order to solve this problem, another composite squirrel cage rotor 30 is proposed as shown in Figs. 5 and 6. This composite squirrel cage rotor 30 includes, two end rings 37. Plurality of holes are formed in each of the end rings 37 and the both ends of the same number of conductor bars 38 are inserted into hoes of two end rings 37 by interference fit,

with appropriate axial load.

The conductor bars 38 are made of copper or aluminum because copper and aluminum, have high electric conductivity. But since copper or aluminum has low stiffness, the conductor bars 38 which have small diameter relative to the axial length are easily buckled by an excessive axial load during the assembly of the squirrel cage conductor.

After the polymer resin part is cured, the squirrel cage conductor combined with the polymer resin part is ground in order to expose the small portion of the conductor bars 38 on its outer surface. If the conductor bars 38 have been buckled, the exposed areas of the conductor bars 38 are not uniform along the axis of the squirrel cage rotor. This may to cause the performance deterioration of the composite squirrel cage rotor.

SUMMARY OF THE INVENTION

Accordingly, the present invention has been considered the above problems occurring in the prior art, and an object of the present invention is to provide a squirrel cage rotor, which has a polymer resin part containing powder of high, magnetic permeability so that the rotor has low mass.

Another object of the present invention is to provide a squirrel cage rotor having a polymer resin part containing powder of high magnetic permeability, which is provided with a plurality of heat pipes to dissipate heat generated by induction operation between the stator and the rotor of motor.

A further object of the present invention is to provide a method for fabricating a squirrel cage conductor, which prevents conductor bars from being buckled.

In order to accomplish the above objects, the; present invention provides a squirrel cage rotor, comprising: a rotating shaft; a polymer resin part containing powder of high

magnetic permeability; and a squirrel cage conductor made of material having high electric conductivity and positioned around the outer portion of the polymer resin part; wherein the powder of high magnetic permeability has a role of increasing the flux density .of rotor and is uniformly distributed in the polymer resin part.

In accordance with a feature of the present invention, the slots of the squirrel cage conductor are provided with a plurality of heat pipes, respectively.

In accordance with a feature of the present invention, the rotor further comprises an inner core of high magnetic permeability so as to guide the magnetic flux from the stator to the rotor of motor.

In accordance with a feature of the present invention, chopped fibers are added to the polymer resin part so as to improve mechanical properties such as thermal stability and stiffness.

In addition, the present invention provides a method for fabricating a squirrel cage rotor, the rotor having a rotating shaft, a plurality of conductor bars, two end rings and a polymer resin part containing powder of high magnetic permeability, comprising the steps of: surrounding each of the conductor bars by a pair of jig; inserting the ends of the conductor bars into the holes of the end rings; removing the jig from each conductor bar; curing the polymer resin part containing powder of high magnetic permeability after inserting the squirrel cage conductor composed of the conductor bars and the end rings into the mold; and grinding of the outer surface of the composite squirrel cage rotor to composed of the conductor bars, the end rings and the polymer, resin part.

In accordance with a feature of the present invention, the jig is fabricated by axially dividing a cylinder into two equal parts, each of the conductor bars is surrounded by the jig, and the jig is shorter than each of the conductor bars in axial length.

In accordance with a feature of the present invention, the method further comprises the steps of fastening band clamp around the jigs surrounding the conductor bars, and removing the band clamp and the jigs from the conductor bars after the assembly of the conductor bars and the end rings.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and other objects, features, and other, advantages of the present invention will be more clearly understood from the following detailed description taken in conjunction with the accompanying drawings, in which:

Fig. 1 is a perspective view of a conventional squirrel cage rotor;

Fig. 2 is a front view of a silicon steel sheet of the squirrel cage rotor;

Fig. 3a is a perspective view of another converitiohal composite squirrel cage type rotor;

Fig. 3b is a perspective view showing the machining of a squirrel cage conductor of the composite squirrel cage rotor;

Fig. 4 is a cross section taken along line A-A of Fig 3a;

Fig. 5 is a perspective view showing the assembly of the conductor bars and end rings of a squirrel cage conductor;:

Fig. 6 is a cross section showing the finished composite squirrel cage rotor of Fig. 5;

Fig. 7 is a perspective view showing the squirrel cage rotor having an inner core and a polymer resin containing powder of high magnetic permeability;

Fig. 8 a is a cross section taken along line B-B of Fig. 7;

Fig. 9 is a schematic diagram explaining a method for fabricating the composite squirrel cage rotor;

Fig. 10 is a diagram showing magnetic flux lines, which are generated while the rotor is placed in a stator;

Fig. 11 is a perspective view showing the process of the assembly of conductor bars and end rings; and

Fig. 12 is a perspective view showing the procedure of the assembly of jig and conductor bars.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Reference now should be made to the drawings, in which the same reference numerals are used throughout the different to drawings to designate the same or similar components.

Hereafter, with reference to accompanying drawings, there is described a squirrel cage rotor having an inner core and a polymer resin part containing powder of high magnetic permeability in accordance with a preferred embodiment of the present invention.

In the drawings, Fig. 7 is a perspective view showing the composite squirrel cage rotor having an inner core and a polymer resin part containing powder of high magnetic permeability. Fig. 8 is a cross section taken along line B-B of Fig. 7. Fig. 9 is a schematic diagram explaining a method for fabricating the composite squirrel cage rotor. Fig. 10 is a diagram showing magnetic flux lines, which is generated while the rotor is placed in a stator.

As depicted in Figs. 7 and 8, the composite squirrel cage rotor 130 of the present invention includes a rotating shaft 131. A polymer resin part 132 is filled around the rotating shaft 131 and is made of polymer resin containing powder of high magnetic permeability. A squirrel cage conductor 133 is positioned around the outer portion of the polymer resin part 132 and is provided with a plurality of axial slots 134. Plurality of heat pipes 135 are inserted into the axial slots 134, respectively.

Powder of high magnetic permeability is employed to enhance magnetic property of polymer resin part. This powder to should be uniformly distributed in the polymer resin part. Chopped fibers with the length of 0.5 to 50 mm may be added to the polymer resin part so as to improve mechanical properties such as thermal stability and stiffness of the rotor structure.

The squirrel cage conductor 133 is fabricated by forming a plurality of axial slots 134 along the axis of a squirrel cage conductor by means of a machining with appropriate tools such as an end mill, an electric discharge machine tool or a laser machine tool. The axial slots 134 are spaced apart from one another by predetermined regular intervals in a circumferential direction.

The squirrel cage conductor 133 may also be fabricated with plurality of conductor bars and two end rings having holes with the same number of conductor bars by inserting the conductor bars into the holes of the end rings.

The slots 134 of the squirrel cage conductor 133 may also be made to have a predetermined angle with the axis.

As mentioned above, the heat pipes 135 are inserted into the slots 134 of the squirrel cage conductor 133 so as to dissipate heat generated during the induction operation. In this case, the heat pipes 135 are fixed in the slots 134 try polymer resin during the curing of the polymer resin part 132. The heat pipe is a sort of cooling device in which heat is transmitted from a heat source to a heat sink while circulating functional fluid, such as ammonia, methanol, Freon or the like, repeats an isothermal cycling process in vacuum sealed pipes. Heat is absorbed in the process of the phase change of the functional fluid from a liquid phase to a gaseous phase when the heat is applied to the heat pipe, gaseous functional fluid moves from a heat source side of the heat pipe to the opposite side, and heat is dissipated in the process of the phase change of the operating fluid from a gaseous phase to a liquid phase,

thereby removing heat.

In order to increase magnetic flux density of the composite squirrel cage rotor, an inner core 136 made of material having high magnetic permeability, such as steel, may be inserted between the rotating shaft 131 and the polymer resin part 132. In this case, the inner core 136 has a. role of guiding magnetic flux from the stator to the mrtor effectively.

Hereinafter, there is described a method for fabricating the composite squirrel cage rotor in accordance with the present invention.

As shown in Fig. 9, the inside surfaces of two steel blocks 191 are ground, and the blocks 141 are brought into contact with each other at their ground surfaces. A mold cavity 142 having a diameter slightly larger than the outer diameter of the composite squirrel cage rotor is machined by means of drilling and boring processes. In order, to align exactly the positions of the two blocks 141, guide pin holes 143 are machined through the blocks 141. The inner surface of mold cavity 142 is coated with a parting agent (not shown), such as Teflon, so as to easily remove the composite squirrel cage rotor from the mold cavity 142 after curing process.

In the slots 134 of the squirrel cage conductor 133, the heat pipes 135 are inserted respectively and this assembly is inserted into the mold cavity 142 of the blocks 141, and fastened by means of guide pins 145 and bolts 146. The rotating shaft 131 is positioned in the center of the squirrel cage conductor 133. And polymer resin containing powder of high magnetic permeability is injected into the mold cavity 142.

As a result, the cavity between the squirrel cage conductor 133 and the inner core 136 and the gaps between the slots 134 of the squirrel cage conductor 133 and the heat pipes 135 are filled with the polymer resin part. Through this process, the rotating shaft 131, the squirrel cage conductor 133 and the heat pipes 135 are combined with one another. Finally,

when the blocks 141 are removed after curing of the polymer resin part, the composite squirrel cage rotor formed of polymer containing powder of high magnetic permeability is completed.

In the method for fabricating the composite squirrel cage rotor, the rotating shaft 131 and the inner core 136, need not to be assembled together with the squirrel cage conductor 133. After disposition of the heat pipes 135 into the slots 134 and inserting the squirrel cage conductor 133 into the mold cavity 142, polymer resin containing powder of high magnetic permeability is injected into themold cavity 142 and is cured in an autoclave under predetermined curing conditions. Accordingly, the polymer resin is cured at the cavity of the squirrel cage conductor 133 and the gaps between the slots 134 and the heat pipes 135.

When the polymer resin part is cured, the center portion of the filled squirrel cage conductor 133 is bored fbr assembly of inner core 136 using a drill. The inner core 136 is inserted into the bored center portion in the center of the composite squirrel cage rotor. The rotating shaft, 131 is inserted into the inner core 136. Through these processes, the composite squirrel cage rotor having a polymer resin part containing powder of high magnetic permeability is completed.

When the composite squirrel cage rotor fabricated as described above is placed in the stator 140, a magnetic field is generated as shown in Fig. 10.

In the drawings, Fig. 11 is a perspective view showing the assembly of conductor bars and end rings. Fig. 12 is a perspective view showing the procedure of the assembly of jig and conductor bars.

As shown in Figs. 11 and 12, each of the conductor bar 236 is surrounded by a pair of jig 200. The conductor bars 236 are made of material having high electric conductivity such as copper or aluminum, whereas the jig 200 are made of material having high stiffness such

as steel.

Each pair of the jig 200 can be fabricated by axially dividing a hollow cylinder 208 into two equal parts. Each pair of jig 200 fabricated as described above surrounds each of the conductor bars 236. The inner diameter, which is defined by each pair of jig 200 while each of jig 200 is brought into contact with each other to form a: hollow cylinder, is smaller than the outer diameter of the conductor bars 236, so that a gap 201 is formed between each pair of jig 200 while each pair of jig 200 surrounds each conductor bar 236.

Each pair of 200 is clamped together by a band camp 203 while enclosing each conductor bar 236. Both ends of each conductor bar 236 are tapered, and the tapered ends of each conductor bar 236 are respectively inserted into the holes formed in two end rings 237. Both ends of the conductor bars 236 are inserted into the holes in the end rings 237 with interference fit. At this time, since each conductor bar 236 is respectively surrounded by each pair of jig 200, the conductor bars 236 are not buckled. After the conductor bars 236 and the end rings 237 are completely assembled together, the band clamps 203 and the jig 200 are removed. As a result, the fabrication of the squirrel cage conductor in which two end rings 237 are assembled by conductor bars 237 is completed.

The obtained squirrel cage conductor is inserted into the mold cavity (not shown in Figs. 11 and 12). In this state, polymer resin (not shown in Figs. 11 and 12) containing powder of high magnetic permeability is injected into and cured between the cavity of the squirrel cage conductor and the mold cavity.

After the polymer resin part containing powder of high magnetic permeability is cured, the blocks 141 are removed. The squirrel cage conductor combined with the polymer resin part is ground at its outer surface, so that the some portion of the conductor bars 236 are axially exposed on the outer surface of the composite squirrel cage rotor. Thus this composite

squirrel cage rotor is completed.

As described above, the present invention provides a composite squirrel cage rotor, which has a polymer resin part containing powder of high magnetic permeability so that the rotor has low mass in comparison with conventional squirrel cage rotors.

Additionally, the present invention provides a composite squirrel cage rotor in which powder of high magnetic permeability is uniformly distributed in the polymet resin part, so that magnetic property is enhanced, thereby improving the performance of the motor.

Additionally, the present invention provides a lightweight squirrel cage rotor, which does not require great driving torque arid which can improve the quality of products thanks to reduction of vibration, stress and inertial force.

Additionally, the present invention provides a squirrel cage rotor, which is provided with heat pipes in order to effectively dissipate heat generated by induction operation therefore this composite squirrel cage rotor has good thermal stability.

Additionally, the present invention provides a method for fabricating the squirrel cage conductor, which can prevent conductor bars from being buckled.

Although the preferred embodiments of the present invention have been disclosed for illustrative purposes, those skilled in the art will appreciate that various modifications, additions and substitutions are possible, without departing from the scope and spirit of the invention as disclosed in the accompanying claims.

WHAT IS CLAIMED IS:

1. A composite squirrel cage rotor, comprising:

a rotating shaft;

a polymer resin part containing powder of high magnetic permeability; and

a squirrel cage conductor positioned around the outer part of the polymer resin part, formed of material having high electric conductivity and provided with a plurality of axial slots;

wherein said powder of high magnetic permeability is uniformly distributed in the polymer resin part.

2. The rotor according.to claim 1, wherein said slots of the squirrel cage conductor are provided with a plurality, of heat pipes, respectively.

3. The rotor according to claim 1, further comprising an inner core of high magnetic permeability so as to improve the performance of the motor by increasing the magnetic flux density of the rotor.

4. The rotor according to any of claims 1 to 3, wherein chopped fibers are added to said polymer resin part in order to enhance the mechanical properties such as thermal stability and stiffness of the rotor structure.

5. A method for fabricating a squirrel cage rotor, said, rotor haring a rotating shaft, a plurality of conductor bars, two end rings and a polymer resin part, comprising the

steps of:

surrounding each of the conductor bars by a pair of jig; inserting the both ends of conductor bars into tie holes of end rings;

removing the jig from each conductor bar;

curing a polymer resin part containcling powder of high magnetic permeability while filling the cavity between the squirrel cage conductor and the mold cavity composed of two blocks; and

grinding the outer surface of composite squirrel cage rotor combined with squirrel cage conductor and the polymer resin part.

6. The method according to claim 5, wherein said jig fabricated by axially dividing a cylinder into two equal parts, each of said conductor bars is surrounded by the jig, and the jig is shorter than each of said conductor bars in axial length.

ABSTRACT

Disclosed herein is, a composite squirrel cage rotor having a polymer resin part containing powder of high magnetic permeability and method for fabricating it. The composite squirrel cage rotor includes a rotating shaft, an inner core, a polymer resin part that fills the cavity of the squirrel cage conductor and contains powder of high magnetic permeability. A squirrel cage conductor is positioned outer to portion of the polymer resin part, is formed of, material having high electric conductivity, and provided with a plurality of axial slots.

FIG. 1

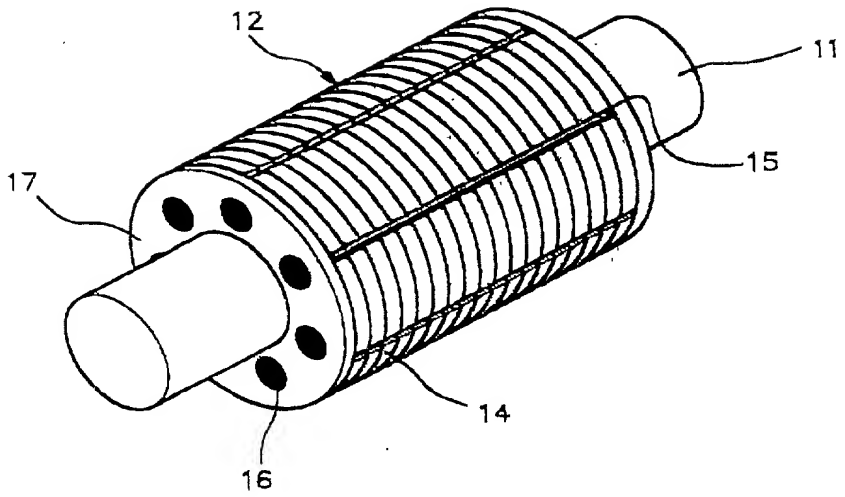


FIG. 2

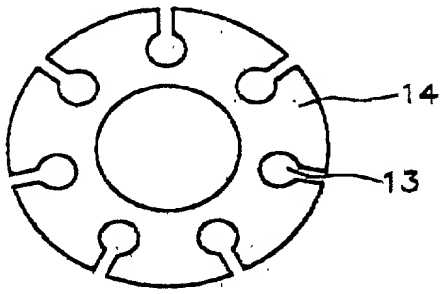


FIG. 3a

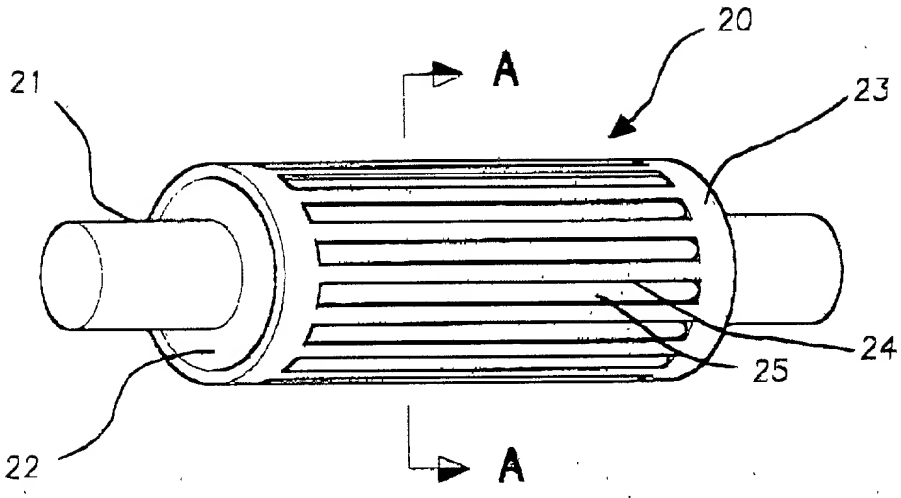


FIG. 3b

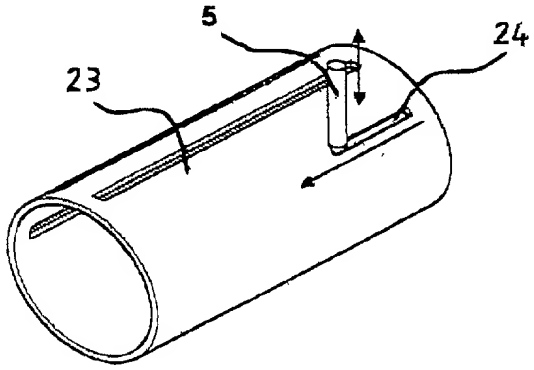


FIG. 4

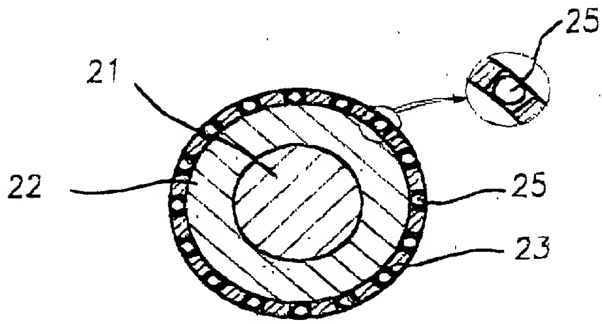


FIG. 5

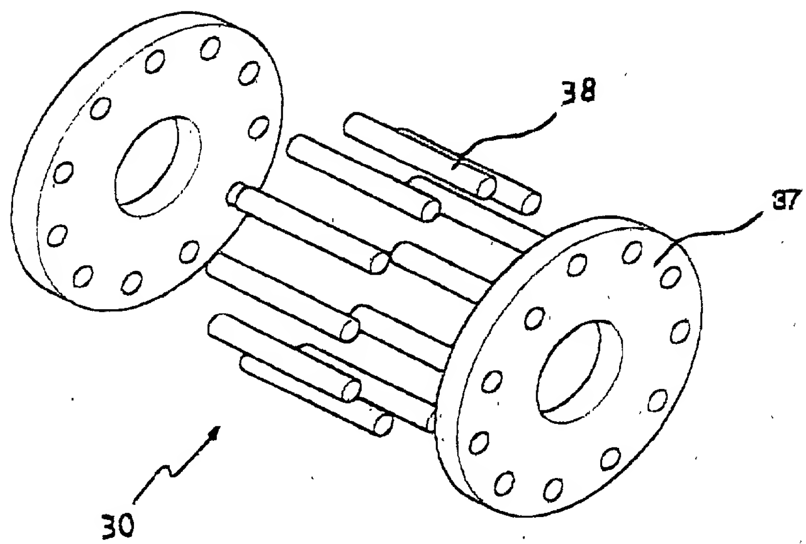


FIG. 6

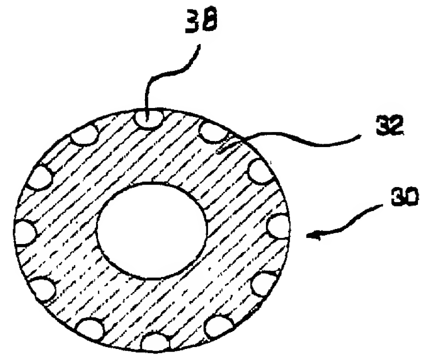


FIG. 7

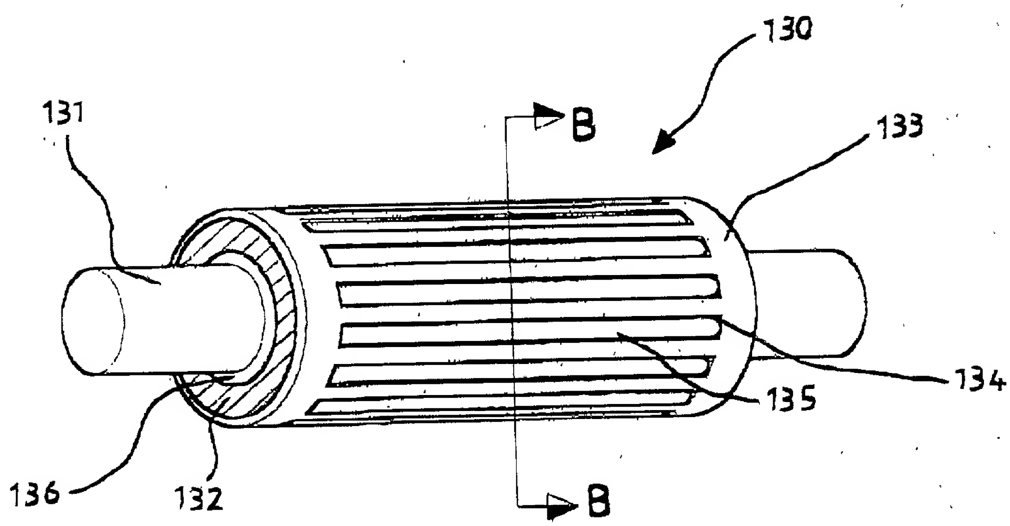


FIG. 8

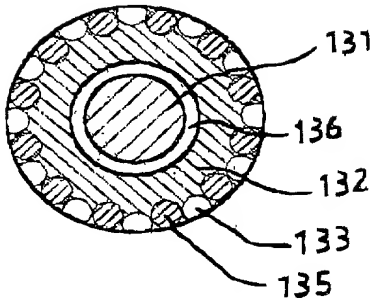


FIG. 9

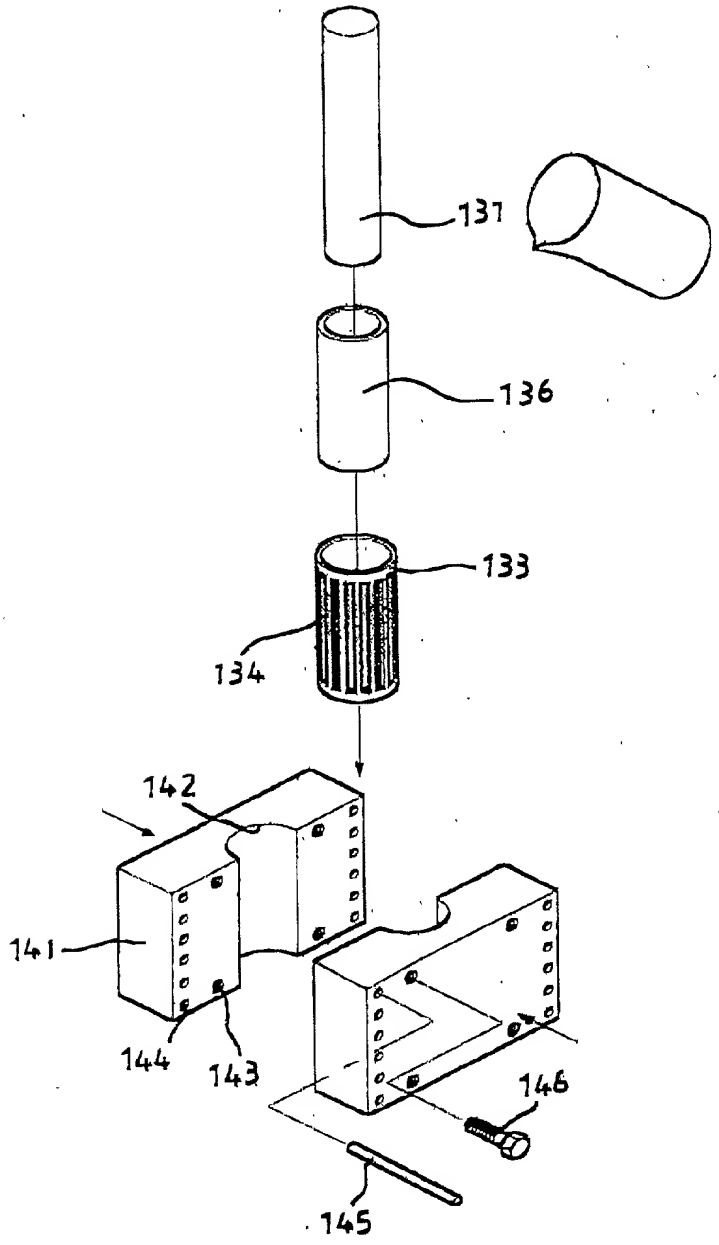


FIG. 10

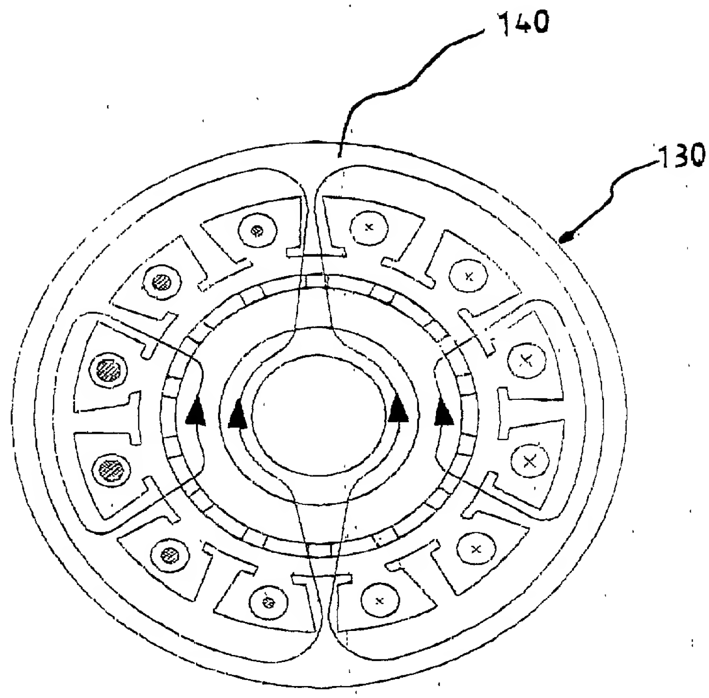


FIG. 11

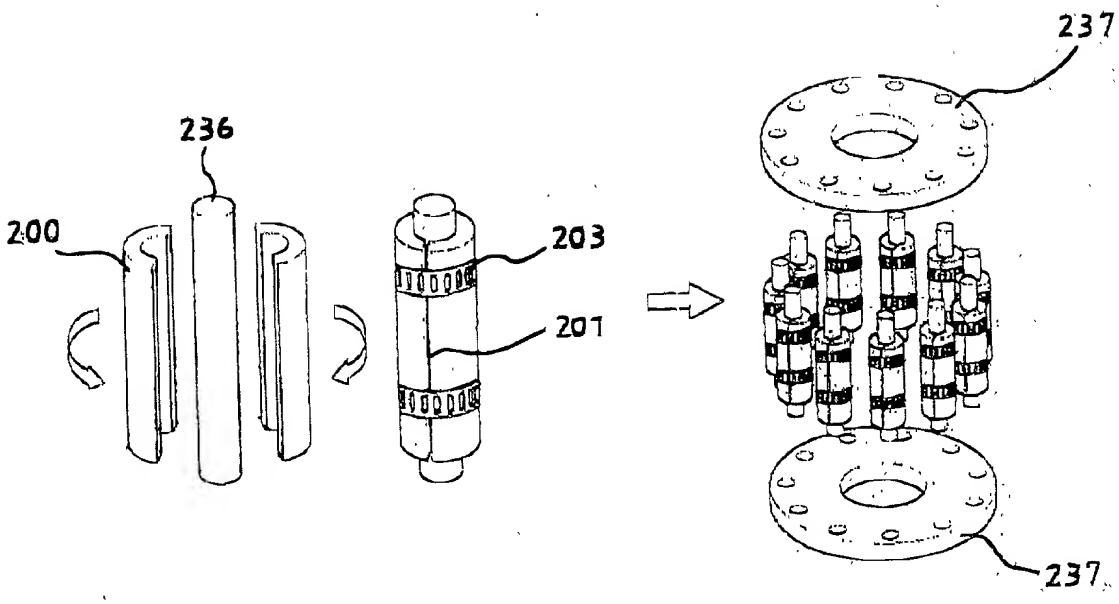
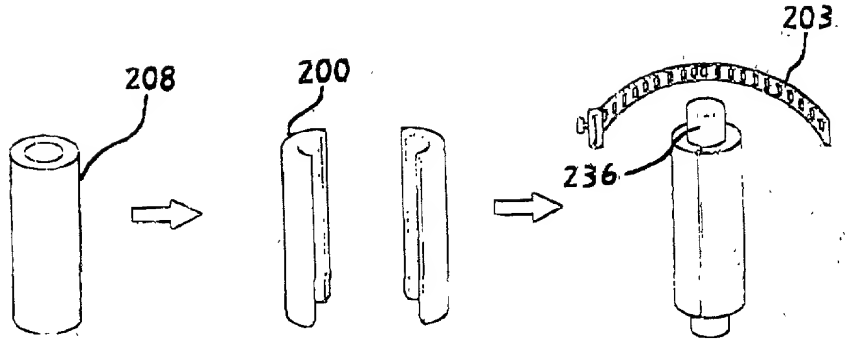


FIG. 12



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DECLARATION FOR UTILITY OR DESIGN PATENT APPLICATION (37 CFR 1.63)

☐ Declaration Submitted with Initial Filing OR ☒ Declaration Submitted after Initial Filing (surcharge (37 CFR 1.16 (e)) required)

Attorney Docket Number	EUN-KAIST
First Named Inventor	Dai Gil Lee
COMPLETE IF KNOWN	
Application Number	TBA
Filing Date	Herewith
Group Art Unit	Unknown
Examiner Name	Unknown

As a below named inventor, I hereby declare

My residence, post office address, and citizenship are as stated below next to my name

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

POLYMER COMPOSITE SQUIRREL CAGE ROTOR WITH HIGH MAGNETIC PERMEABILITY FILLER OF INDUCTION MOTOR AND METHOD OF MAKING IT

(Title of the Invention)

the specification of which
☐ is attached hereto
OR
☒ was filed on (MM/DD/YYYY) [ ] as United States Application Number or PCT International Application Number TBA and was amended on (MM/DD/YYYY) [ ] (if applicable)

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment specifically referred to above

I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR 1 56.

I hereby claim foreign priority benefits under 35 U S.C 119(a)-(d) or 365(b) of any foreign application(s) for patent or inventor's certificate, or 365(a) of any PCT international application which designated at least one country other than the United States of America, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate, or of any PCT international application having a filing date before that of the application on which priority is claimed

Prior Foreign Application Number(s)	Country	Foreign Filing Date (MM/DD/YYYY)	Priority Not Claimed	Certified Copy Attached? YES	NO
1999-49704	KR	10 November 1999	☐	☒	☐
2000-04587	KR	31 January 2000	☐	☒	☐
			☐	☐	☐
			☐	☐	☐

☐ Additional foreign application numbers are listed on a supplemental priority data sheet PTO/SB/02B attached hereto.

I hereby claim the benefit under 35 U.S.C 119(e) of any United States provisional application(s) listed below

Application Number(s)	Filing Date (MM/DD/YYYY)
None	

☐ Additional provisional application numbers are listed on a supplemental priority data sheet PTO/SB/02B attached hereto

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DECLARATION — Utility or Design Patent Application

I hereby claim the benefit under 35 U.S.C. 120 of any United States application(s), or 365(c) of any PCT international application designating the United States of America, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of 35 U S.C. 112, I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR 1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application

U.S. Parent Application or PCT Parent Number	Parent Filing Date (MM/DD/YYYY)	Parent Patent Number *(if applicable)*
None		

☐ Additional U.S. or PCT international application numbers are listed on a supplemental priority data sheet PTO/SB/02B attached hereto.

As a named inventor, I hereby appoint the following registered practitioner(s) to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith:

☐ Customer Number [ ] → *Place Customer Number Bar Code Label here*

OR

☒ Registered practitioner(s) name/registration number listed below

Name	Registration Number	Name	Registration Number
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Lee J. Fleckenstein	36,136	Laurence S. Roach	45,044
Ronald J. Kisicki	38,205	Stephen J. Sand	34,716

☐ Additional registered practitioner(s) named on supplemental Registered Practitioner Information sheet PTO/SB/02C attached hereto.

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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true, and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 18 U S.C. 1001 and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Name of Sole or First Inventor: ☐ A petition has been filed for this unsigned inventor

Given Name (first and middle [if any])	Family Name or Surname
Dai Gil	Lee

Inventor's Signature						Date	
Residence: City	Taejon	State		Country	Rep. of Korea	Citizenship	Korean
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☐ Additional inventors are being named on the 1 supplemental Additional Inventor(s) sheet(s) PTO/SB/02A attached hereto

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DECLARATION

ADDITIONAL INVENTOR(S)
Supplemental Sheet
Page 1 of 1

Name of Additional Joint Inventor, if any:				☐ A petition has been filed for this unsigned inventor			
Given Name (first and middle [if any])				Family Name or Surname			
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Name of Additional Joint Inventor, if any:				☐ A petition has been filed for this unsigned inventor			
Given Name (first and middle [if any])				Family Name or Surname			
Inventor's Signature					Date		
Residence City		State		Country		Citizenship	
Post Office Address							
Post Office Address							
City		State		ZIP		Country	

Name of Additional Joint Inventor, if any:				☐ A petition has been filed for this unsigned inventor			
Given Name (first and middle [if any])				Family Name or Surname			
Inventor's Signature					Date		
Residence. City		State		Country		Citizenship	
Post Office Address							
Post Office Address							
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